

January 24, 1975

Dr. Joseph P. Kerwin  
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Lyndon B. Johnson Space Center  
Houston, Texas 77058

Dear Dr. Kerwin,

This is to respond to your letter of January 3rd and to the draft recommended program plan on life sciences, appendix 12, Outlook for Space 1980-2000.

As I read the paper, I found in it a number of ideas that were provocative and that I might have been too ready to dismiss out of hand before giving them more careful deliberation. After further study I would have to say that the draft contains a number of very interesting and probably productive ideas; at the same time there are others that are so inherently implausible that they should be reexamined very critically and in some instances undoubtedly scrapped.

In general I would be the most skeptical of those suggestions that imply the use of the space environment as a routine operational context for therapy, for diagnosis, even for research or for production. Even if the marginal costs of space transportation should be greatly reduced, either as a result of enormous technical strides, or of the absorption of fixed costs by investment in space for other motives, it seems very likely that for most purposes one will eventually find much cheaper implementations on earth. On the other hand, the space environment may be the only way to investigate some fundamental phenomena, insight into which may then lead to a variety of technical implementations. The therapeutic use of the space environment will almost certainly follow this principle and I suspect that the same will hold for a number of the production processes where control of the gravitational environment seems to be the key issue. The credibility of the proposals is hindered by insistence on the same framework for large scale implementation and for the initial inquiry.

I will turn now to specific points in the draft by heading and number. I think you have put first things first in your discussion beginning at page 3. Weightlessness is unlikely to prove to be a really cogent experimental variable for those biological situations that are already unresponsive to drastic changes in orientation. For example, if we routinely grow bacteria in cultures that are violently tumbled; and at the same time can manage pretty well in still cultures; it is hard to believe that we are going to find exciting effects in a zero G environment. Even there we have no way to control the sporadic

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1/24/75

accelerations that are the results of Brownian movement of particles on that scale. Hence, to begin with indisputable empirical observations such as those that have been observed in human space flight is the most appropriate and the issues raised under A1-5 are certainly of the greatest importance not only for astronautics but for a spill-over into terrestrial medicine. They do not reflect the highest priorities for medical research but this is such a tightly interconnected web that it is impossible to predict where one will find the most promising leads for dealing with major health problems.

On the other hand, I would be very cautious about trying to include persuasive remarks about the operational use of weightlessness for the reasons stated before.

C. The medical use of space communications is already under way. (Consult Dr. Frank Kuo, Aloha System, University of Hawaii/Menlo, 2540 Dole Street, Honolulu, Hawaii 96822).

D. I can understand the synoptic ecology aspects of vector control. But the references to Monitoring E. coli make no sense to me. Do you mean "sonobuoys" with automated E. coli sensors that need space communication links? As the significant sites adjoin dense settlement that sounds far-fetched!

E. I buy the physiological studies. The idea of following genetic adaptation to zero-G in anything larger than a fruit-fly would call for larger experiments in space than have even been done on earth! (One has to think of a minimum of 10 generations for populations of  $10^5$  individuals for meaningful experiments on evolution).

I would reject all but E1 and E5 as adjuncts to A.

F. A/ok and the rest of the paper.

Sincerely yours,

Joshua Lederberg  
Professor of Genetics